

Educational and organisational interventions used to improve the management of hypertension in primary care: a systematic review

Tom Fahey, Knut Schroeder and Shah Ebrahim

ABSTRACT

Background

The optimal way in which to organise and deliver care to patients with hypertension has not been clearly identified.

Aim

To determine the effectiveness of educational and organisational strategies used to improve control of blood pressure.

Design of study

Systematic review of randomised controlled trials (RCTs).

Method

Quantitative pooling of RCT data on patients with hypertension that evaluated the following interventions: (1) self monitoring, (2) educational interventions directed to the patient, (3) educational interventions directed to the health professional, (4) health professional (nurse or pharmacist) led care, (5) organizational interventions that aimed to improve the delivery of care, (6) appointment reminder systems.

Results

Fifty-six RCTs met our inclusion criteria. The methodological quality of included studies was variable. An organised system of regular review allied to vigorous antihypertensive drug therapy was shown to reduce blood pressure (weighted mean difference -8.2/-4.2mmHg, -11.7/-6.5mmHg, -10.6/-7.6mmHg for three strata of entry blood pressure) and all-cause mortality at 5 years follow-up (6.4% versus 7.8%, difference 1.4%) in a single large RCT (the Hypertension Detection and Follow-up study). Other interventions had variable effects. Self-monitoring was associated with moderate net reduction in diastolic blood pressure, weighted mean difference (WMD): -2.03 mmHg, 95% confidence interval (CI) = -2.7 to -1.4 mmHg. Educational interventions directed towards physicians were associated with small reductions in systolic blood pressure (WMD) -2.0mmHg, 95% CI = -3.5 to -0.6mmHg and diastolic blood pressure (WMD) -0.4mmHg, 95% CI -1.1 to 0.3mmHg.

Conclusions

General practices and community-based clinics need to have an organised system of regular follow-up and review of their hypertensive patients. Antihypertensive drug therapy should be implemented by means of a vigorous stepped care approach when patients do not reach target blood pressure levels. These findings have important implications for recommendations concerning implementation of structured delivery of care in hypertension guidelines.

Keywords

hypertension; systematic review; prevention and control.

INTRODUCTION

Hypertension is an important public health problem. Evidence from randomised controlled trials (RCTs) has shown that effective drug treatment reduces the risk of cardiovascular morbidity and mortality.¹ There is concern that the benefits demonstrated in randomised trials of antihypertensive drug treatment are not implemented in everyday clinical practice.² Community-based studies throughout the world show that blood pressure goals are achieved in only 25-40% of the patients who take antihypertensive drug treatment,²⁻⁵ which is a situation that has remained unchanged for the last 30 years.⁶

The quality of care that patients with hypertension receive from family physicians has a clear impact on their risk of suffering a cardiovascular event. Observational studies have shown that inadequate control of blood pressure is associated with a significant risk of stroke.^{7,8} In terms of the process of care that hypertensive patients receive, characteristics of both the patient, health professional and the healthcare system in which they are given their medical care have been implicated in poor blood pressure control. Lack of adherence to medication and not having a primary care physician were associated with

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How this fits in

Half of all patients with hypertension who take antihypertensive drug therapy fail to reach blood pressure treatment goals. While there is a strong evidence-base for the benefits of antihypertensive drug therapy, there is little clear evidence as to how care for hypertensive patients should be organised and delivered in primary care. This systematic review of 56 randomized controlled trials (RCTs) shows that an organised system of regular follow up and review of hypertensive patients results in improvement in blood pressure control. Education directed to patients or health professionals alone has only a marginal impact in terms of improved blood pressure control. Self monitoring of blood pressure and health professional-led care (nurses or pharmacists) appear promising interventions but require further evaluation.

poor blood pressure control.⁹ More recent studies have shown that frequent contact with health care professionals does not guarantee better blood pressure control unless there is more vigorous use of antihypertensive drugs,¹⁰ and that individual practitioners vary substantially in their clinical performance when managing hypertension in the community.¹¹ In diabetic patients with poor blood pressure control, the overall quality of care depends most critically on organisational and structural factors rather than clinical practice guidelines.¹² These observations have led some commentators to suggest that poor control of blood pressure in the community may be due to ineffective management and inadequate practice organisation, described jointly as 'clinical inertia'.¹³

While there is a strong evidence-base for the benefits of antihypertensive drug therapy,¹ there is little clear evidence as to how care for hypertensive patients should be organised and delivered in the community. The aim of this study was to systematically review RCTs that evaluate different strategies of care used to improve the control and follow up of patients with hypertension.

METHOD

Searching

We identified original RCTs by an all-language search of all articles (any year) in the Cochrane Controlled Trials Register (CCTR), Medline and Embase (search strategy shown in Supplementary Box 1) in August 2004. We screened the references of all retrieved articles to identify additional publications and contacted experts in the field about other relevant trials or unpublished material.

Study selection

We selected studies for review if:

- the population of interest was composed of adult patients with essential hypertension (treated or not currently treated with blood pressure lowering drugs) in a primary care, outpatient or community setting;

- the interventions were aimed at improving control of blood pressure or clinic attendance and were classified as: (1) self monitoring, (2) educational interventions directed to the patient, (3) educational interventions directed to the health professional, (4) health professional (nurse or pharmacist) led care, (5) organisational interventions that aimed to improve the delivery of care, (6) appointment reminder systems;
- if studies reported on any of the following: (1) mean systolic blood pressure (mean SBP) and/or mean diastolic blood pressure (mean DBP), (2) control of blood pressure (3) proportion of patients followed up at clinic.

Included studies had to be RCTs with a contemporaneous control group where patient care in the intervention group(s) was compared with either no intervention or usual care. We excluded studies using interventions not intended to increase blood pressure control by organisational means, particularly drug trials and trials of non-pharmacological treatment. This review has been registered as a protocol on the Cochrane Library.¹⁴ Classification of interventions was based on a previous review by one of us,¹⁵ and by our knowledge of the literature at the time of writing the protocol for the review.

Two of the authors assessed lists of citations and abstracts independently. We were not masked with regard to authors or journal. Each reviewer indicated whether a citation was potentially relevant (that is, appearing to meet the inclusion criteria), was clearly not relevant, or gave insufficient information to make a judgement. To be included a study had to meet all the inclusion criteria. We resolved differences by discussion and obtained reprints of all potentially relevant citations.

Data extraction

We independently extracted data in duplicate on study design, methods, clinicians and patients, interventions, outcomes and potential sources of bias using a structured data collection form. We wrote to corresponding authors of studies to request missing data, clarify study details and enquire about unpublished studies.

Quality assessment

For assessment of study quality we collected data on randomisation procedure, allocation concealment, blinding of participants, providers of care, outcome assessors and losses to follow up.¹⁶

Quantitative data synthesis

We examined the effects on: 1) blood pressure between interventions at follow up (systolic and

diastolic blood pressure) according to the six pre-defined intervention categories. We compared and pooled the mean blood pressure differences from baseline to final follow-up in the intervention and control groups using the weighted mean difference approach recommended by the Cochrane Heart Group (<http://www.epi.bris.ac.uk/cochrane/stats3.html>). When only partial information about the variance was provided in RCT reports, we calculated variances using the method described by Follman.¹⁷ We have taken account of the correlation of baseline and final blood pressure measurements by using empirical data from the Caerphilly dataset which examined the correlation between baseline and 5-year follow-up blood pressure measurements in 2000 men ($r = 0.568$ for systolic and $r = 0.514$ for diastolic blood pressure) (personal communication Margaret May, Department of Social Medicine, University of Bristol, 2004).

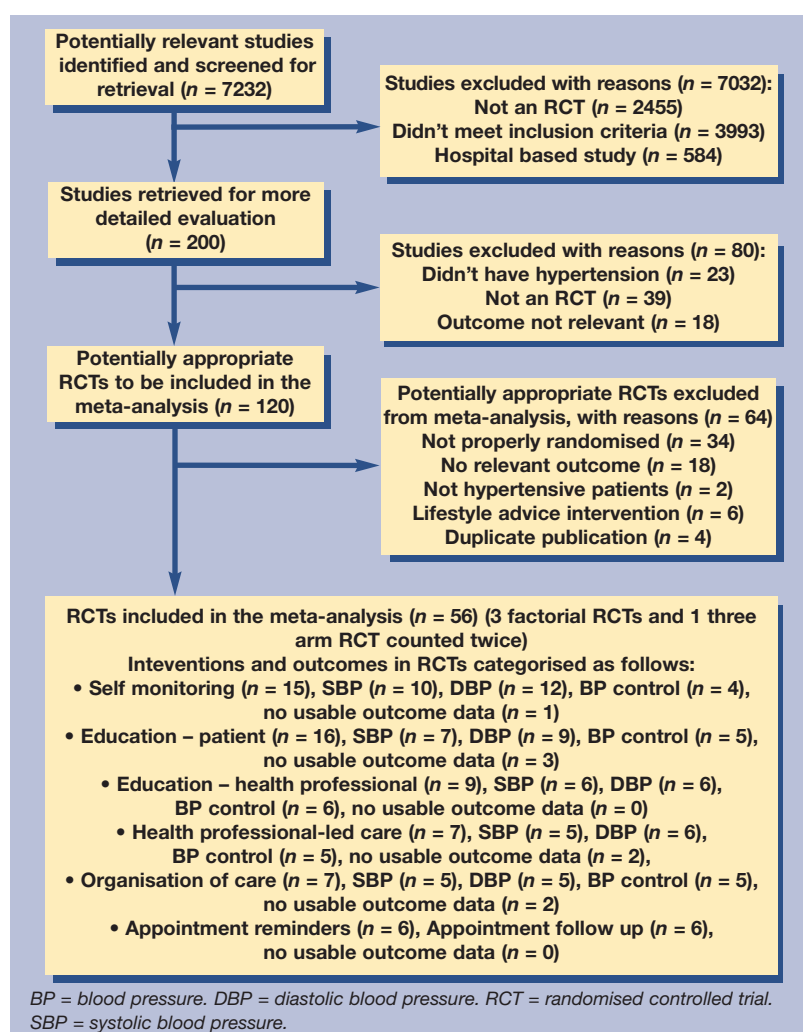
For blood pressure control and clinic attendance at follow up, statistical and clinical significance was evaluated by means of estimating odds ratios with 95% confidence intervals (CIs). Individual study definitions of control of blood pressure and attendance at clinic were used. For both continuous and categorical outcomes, we checked the meta-analyses for heterogeneity by visual inspection and by Cochran's test. When heterogeneity is significant, the range of individual study results are presented to illustrate the magnitude of blood pressure reduction reported but no overall pooled results are presented. Pooled relative risks and their 95% CIs were calculated with the Cochrane Collaboration Review Manager 4.2 software.

RESULTS

Trial flow, study characteristics and quality

Figure 1 shows details of exclusion and inclusion of studies. Supplementary Table 1 summarises the characteristics of 56 included RCTs. Three RCTs had a factorial design and are included twice under separate intervention headings: Pierce (self monitoring and education [patient]);¹⁸ Sackett (education [patient] and organisation of care);¹⁹ and Dickinson (education [health professional] and organization of care).²⁰ Another RCT had three separate arms of patient education, home monitoring from a family member actively participating in their care and a usual care arm.²¹

The reported methodological quality of included studies was generally poor to moderate (full data available from authors). Nineteen RCTs (34%) stated the randomisation process, while only six (11%) had adequate allocation concealment. In 11 studies (20%) the outcome assessors were blind to the treatment allocation. Loss to follow-up of 20% or more occurred in 12 (21%) of studies.



Effect on mean systolic blood pressure, diastolic blood pressure and blood pressure control

The impact of interventions is summarised in Table 1 (full data available from authors). There was substantial heterogeneity for several interventions and outcomes. In these situations, pooled data are not reported but the range of results from individual RCTs are presented.

Self monitoring ($n = 15$ RCTs)^{18,21–34} was associated with significant between-group heterogeneity for mean systolic blood pressure (SBP) (range -10 to 5 mmHg). Pooled data from 12 RCTs on difference of mean diastolic blood pressure (DBP), showed that self-monitoring was associated with a significant reduction of -2.0 mmHg (95% CI = -2.7 to -1.4 mmHg). In the four RCTs that reported on control of blood pressure, there was a trend towards improved blood pressure control but this was not significant (odds ratio [OR] = 0.9; 95% CI = 0.8 to 1.1). The remaining RCT that did not report any usable data concerning blood pressure control, reported a mean arterial blood pressure difference of 3 mmHg in favour of the intervention.³¹ However, this RCT was of a short duration (8 weeks follow-up).

Figure 1. Progress through stages of systematic review.

Table 1. Summary of results of interventions on systolic and diastolic blood pressure, control of hypertension and follow up at clinic.

Intervention	Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)		Blood pressure control (odds ratio) ^a	
	Pooled estimate (95% CI)	Range of results from individual RCTs	Pooled estimate (95% CI)	Range of results from individual RCTs	Pooled estimate (95% CI)	Range of results from individual RCTs
Self monitoring		-10-5	-2.0 (-2.7 to -1.4) ^b	-12-0	0.9 (0.8 to 1.1)	0.8-1.2
Education (patient)		-16-1		-9-7	0.7 (0.4 to 1.0)	0.3-1.1
Education (physician)	2.0 (-3.5 to -0.6) ^b	-7-1	-0.4 (-1.1 to 0.3)	-2-1		0.8-1.0
Health professional care		-13-0		-8-0		0.1-0.9
Organisational interventions		-12-3		-8-5		0.5-1.8
Intervention	Follow up at clinic (relative risk)					
	Pooled estimate (95% CI)	Range of results from individual RCTs				
Appointment reminders		0.1-1.4				

^aOdds ratio of control of blood pressure ('control' blood pressure threshold definition taken as that used in each individual randomised controlled trial), RR <1 blood pressure control greater in intervention group >1 blood pressure control greater in control group. ^bP<0.05. Note: no results reported = heterogeneous results; no pooled estimate reported. CI = confidence interval.

The largest outlying RCT evaluated self monitoring as an intervention but without any adjustment in target blood pressure for self monitoring patients. The consequence was that self monitoring patients were less likely to have their medicines increased and more likely to have them reduced or ceased.²² Similarly, we excluded a recently published RCT of self monitoring whose objective was to 'compare self measurement and conventional office measurement of blood pressure as guides to initiate and titrate antihypertensive drug treatment'.³⁵ In this study goal diastolic blood pressure was 80-89 mmHg for both groups based on self monitoring or office reading (based on the allocation of the patient). At follow up, more self monitored patients had stopped antihypertensive treatment but with final office and 24-hour ambulatory readings being higher in the self monitoring group. The issue of using self monitoring as a diagnostic test evaluation to establish sustained blood pressure or as a therapeutic tool (with clear treatment goals adjusted to compensate for the lower self monitoring blood pressure readings that can be expected) to aid patient involvement and concordance needs to be clarified in future studies.

Educational interventions directed to the patient ($n = 16$ RCTs),^{18,19,21,36-51} seven RCTs reported mean difference SBP, nine RCTs reported mean difference DBP and five on BP control. For mean difference in SBP and DBP outcomes pooling of results from individual RCTs produced heterogeneous results, so pooled mean differences are not reported. Mean difference in SBP was reported with a range of differences in mean SBP reported between -15.7 mmHg to 0.6 mmHg, mean difference in DBP was reported with a range DBP -8.7 mmHg to 7.1 mmHg. In terms of blood pressure control (five RCTs) there was a trend towards improved blood pressure control but this was not significant (OR = 0.7

(95% CI = 0.4 to 1.0). Three RCTs did not report relevant outcome data,³⁹⁻⁴¹ but did report increases in patient knowledge.⁴¹ Two of these RCTs reported no difference in blood pressure control.^{39,41} One RCT reported an improvement in SBP but not DBP at 6 months follow-up.⁴⁰

Educational interventions directed to the physician ($n = 9$ RCTs),^{20,52-59} were associated with a small reduction in systolic blood pressure, pooled mean difference in SBP was -2.0 mmHg, 95% CI = -3.5 to -0.6 mmHg. However, they were not associated with a significant decrease in mean DBP (mean difference -0.4 mmHg, 95% CI = -1.1 to 0.3 mmHg) while control of blood pressure produced heterogeneous results (reported range 0.8 to 1.0).

Health professional (nurse or pharmacist) led care ($n = 7$ RCTs),⁶⁰⁻⁶⁶ for all three outcomes pooling of results from individual RCTs produced heterogeneous results, so pooled mean differences are not reported. However, nearly all individual RCTs produced favourable results. Mean difference in SBP was reported in five RCTs with a range of difference in mean SBP from -13-0 mmHg. Mean difference in DBP was reported in six RCTs, ranging from -8-0 mmHg. Control of blood pressure produced heterogeneous results (reported range 0.1-0.9).

Organisational interventions ($n = 7$ RCTs),^{19,20,67-75} for all three outcomes pooling of results from individual RCTs produced heterogeneous results, so pooled mean differences are not valid and the range of mean difference in SBP and DBP is reported in Table 1. Of note, the largest RCT, the Hypertension Detection and Follow-Up Program (HDFP), produced substantial reductions in SBP and DBP across the strata of blood pressure entry level in this RCT (patient were stratified according to level of entry DBP level, weighted mean difference -8.2/-4.2 mmHg, -11.7/-6.5 mmHg, -10.6/-7.6 mmHg for the three strata of entry blood

pressure). At 5 year follow-up these reductions in blood pressure were associated with a significant reduction in all cause mortality at 5 years follow-up (6.4% versus 7.8%, risk difference 1.4%).

Appointment reminder systems ($n = 6$ RCTs)⁷⁶⁻⁸¹ in five RCTs reminder systems were associated with an improvement in follow-up (one RCT of a mailed postcard reminder was not associated with improved follow-up).⁷⁶ The pooled results, though favouring appointment reminder systems for follow-up of patients, OR of being lost to follow-up 0.41, 95% CI = 0.32 to 0.51 are heterogenous because of a single outlying RCT. The pooled results should be treated with caution. Four other RCTs (studies classified under the other intervention headings but incorporated some form of reminder intervention such as postal reminders or computer generated feedback) were associated with significantly improved follow-up attendance by patients.^{20,40,62,74,75}

DISCUSSION

Summary of main findings

The main finding from this systematic review are to a large extent dominated by the findings from the largest RCT, the HDPF study (Table 1).^{71,72,82} Though principally intended as a trial to assess the value of systematic identification of hypertensive patients,⁸² the key ingredients of how patients with established hypertension were managed — free care, registration, recall and regular review in tandem with a rigorous stepped care approach to antihypertensive drug treatment — should be emphasised as this multi-faceted intervention was effective in terms of reaching blood pressure goals and reducing all-cause mortality. It is interesting to note that a 2-year post trial surveillance study showed that blood pressure control was attenuated when the stepped-care arm of the study was discontinued. This lack of control was associated with a decline in the use of antihypertensive medication.⁸⁴ Some caution is required when interpreting this RCT as it included both untreated and uncontrolled hypertensive subjects with differential uptake of antihypertensive treatment in the intervention and usual care arms of the study.

Other interventions assessed in this systematic review did not produce clear results. None of the interventions were associated with large, clinically important, reductions in either SBP or DBP (Supplementary Table 1 and Table 1). Self-monitoring is associated with a significant decline in DBP and further evaluation is warranted. Education alone, directed either to patients or health professionals appears unlikely to influence control of blood pressure as a single intervention, as results were highly heterogeneous or of marginal clinical importance. Use of health care professionals such as nurses and

pharmacists, though producing significantly heterogeneous results in terms of mean SBP and DBP, did have mainly favourable results and was associated with improved control of blood pressure. Lastly, reminders (postal or computer-based) were associated with an improvement in the follow up of patients with hypertension in all RCTs aside from one small study.⁷⁶ This finding is consistent with the organisational structure of the HDPF study and reiterates the importance of systematic recall systems when organizing care for hypertensive patients.

Comparison with existing literature

The elements identified from this review that are associated with improved blood pressure control are consistent with findings from observational research. Patients who receive intensive antihypertensive drug therapy are significantly more likely to have reduced systolic blood pressure (-6.3 mmHg) compared those who do not (4.8 mmHg).¹⁰ Antihypertensive drug therapy is initiated or changed in only 38% of episodes of care in patients with sustained (at least 6 months duration) uncontrolled hypertension.⁸⁵ Lack of practice organisation, coupled with failure to intensify treatment has been characterized as 'clinical inertia' and is implicated as a reason with a failure to achieve treatment goals in hypertension, diabetes and secondary prevention of coronary heart disease.¹³ A recent systematic review of RCTs of self monitoring also produced similar findings of modest but potentially important benefit.⁸⁶

Previous reviews on chronic disease management have suggested that education, directed at either the patient or health professional alone, may be associated with improved blood pressure control.⁸⁷ This current systematic review, based on a larger number of RCTs (16 RCTs where education was directed to the patient, nine RCTs where the educational intervention was directed to the physician, compared to a total of eight RCTs identified from the previous review), does not support this finding.

Limitations of the study

There are several shortcomings that need to be highlighted in this systematic review. As we have highlighted, HDPF was designed as an intervention that would identify newly diagnosed hypertensive patients and then start or modify antihypertensive treatment in those with untreated as well as uncontrolled hypertension.⁸² A consequence of this study design is that a differential number of people were receiving antihypertensive drug treatment in the two arms throughout the duration of this RCT (81% in intervention arm versus 64% in usual care arm at 5 years follow up). So though it appears that the systematic follow up and stepped care approach in

HDFP is an important element in effective clinical care and prompts rigorous antihypertensive drug treatment, it is not possible to distinguish between the independent effect of these interventions on blood pressure control. Several other RCTs included both treated and untreated hypertensive patients and had differential rates of antihypertensive drug prescribing,^{30,33,34,56} with rates of prescribing at higher levels in the intervention arm at follow up. Secondly, many RCTs contained multi-faceted interventions that did not fit into a single intervention category (Supplementary Table 1). For example, several RCTs that were included under categories of patient education, physician education, health professional led care and organisation of care also incorporated some form of reminder intervention such as postal reminders or computer generated feedback.^{20,40,62,75} Consequently, it has been difficult to attribute how far single elements that make up complex interventions exert their independent effect on blood pressure control. In terms of self monitoring, it is well established that 'office' blood pressure readings are around 10/5mmHg higher when compared to ambulatory or self monitored readings.^{35,87,88} Several of the RCTs did not make any recommendations about the need for adjustment of target blood pressure readings when self monitoring was the intervention being assessed, nor did they appear to anticipate lower blood pressure readings in the self monitoring group.^{18,22,26} This may have attenuated the impact of self monitoring on blood pressure control because of failure to intensify treatment. Poor adherence to antihypertensive drug treatment is thought to be associated with poor control of blood pressure. Only a few trials examined the relation between adherence to medication and control of blood pressure.^{19,25,26} Lastly, not all RCTs reported on the outcomes of blood pressure level achieved or blood pressure control. This has meant that the relevant *a priori* outcomes have not been reported for all included RCTs, and pooling of data from all RCTs has not been possible.

Implications for clinical practice and treatment guidelines

Despite these limitations important messages emerge from this systematic review. Effective delivery of hypertensive care requires a systematic approach in the community, incorporating regular review of patients and a willingness to intensify antihypertensive drug treatment, usually by adding additional classes of antihypertensive drugs, when blood pressure goals are not being met. This approach of intensive drug therapy and 'tight' control of blood pressure has been demonstrated to be possible in clinical trials in hypertensive and diabetic patients alike.^{89,90} These findings recognise that it is the system of care, not the

specialty of the physician, that determines high quality chronic disease management.⁹¹ Clinical practice guidelines need to reflect more clearly the current evidence concerning implementation of educational and organisational interventions, and how this evidence fits into an organized and effective system for delivering high quality care to hypertensive patients in the community.^{88,92} Lastly, it should be recognised that even in well funded antihypertensive drug trials achieving control of blood pressure — particularly systolic blood pressure — is neither 'frequently nor easily obtained'.⁹³⁻⁹⁵

Implications for future research

Aside from definitive RCTs examining the effects of self-measurement and allied health professional led care (pharmacist and nurses), there is also a paucity of evidence in terms of computer-based clinical decision support systems (CDSSs) in hypertension and how adherence-enhancing strategies influence subsequent blood pressure control.¹⁵ In addition, the relationship between adherence and control of blood pressure in the context of organisational, educational and self monitoring interventions needs further evaluation.⁹⁶ HDFP was a well-funded study with substantial staffing resources. This meant that the 'stepped care' intervention was provided by a highly motivated workforce. An economic evaluation of delivering organised care to hypertensive patients should accompany future studies.

Effective delivery of hypertension care in the community requires a rigorous approach in terms of identification, follow up and treatment with antihypertensive drugs. This systematic review shows that such an approach is likely to translate into reductions in cardiovascular mortality and morbidity.⁸² Supplementary and alternative models of care, including self monitoring of blood pressure by patients, blood pressure management by allied health care professionals and CDSSs require further development and evaluation. Educational interventions directed to either patients or health professionals alone are unlikely to produce clinically important reductions in either systolic or diastolic blood pressure.

Supplementary information

Additional information accompanies this article at <http://www.rcgp.org.uk/journal.index.asp>

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Competing interests

None

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